REMARKS

Claims 1, 2, 5-11, 14-16, 19-21 and 24 are pending in the application.

I. Examiner Interview of March 9, 2007

The undersigned conducted a telephone interview with the Examiner on March 9, 2007.

In the interview, counsel discussed the outstanding 35 U.S.C. §112, first paragraph "written description" rejection.

Counsel submitted the description at page 1, line 26 to page 2, line 2 of the specification adequately conveys to persons skilled in the art that Applicant described hollow carbon nanocapsules having a purity of at least more than 50% as his invention. The specification expressly states that "processes producing high-purity hollow carbon nanocapsules … have been developed," and persons skilled in the art would readily recognize that the copending applications being cited in further support of this proposition are Applicant's U.S. Application Nos. 10/329,333 (now U.S. Patent 6,872,236) and 10/255,669 (now U.S. Patent 7,156,958). These documents describe the preparation of hollow carbon nanocapsules having a high purity of at least more than 50%.

The Examiner indicated that he would reconsider the rejection.

Regarding the 35 U.S.C. §103(a) rejection, counsel distinguished the present invention from Lieber. For example, counsel pointed out that Applicant's nanocapsules had a low aspect ratio, approximating 1, whereas Leiber's nanotubes have a relatively high aspect ratio of 10 to about 2,000. The Examiner appreciated this distinction. Counsel also pointed to the claims, which are not directed to nanotubes, but rather nanocapsules. The Examiner suggested that he would likely reconsider the rejection based on Leiber, Uchida and Hiura in light of these distinctions.

Counsel further explained that Applicant's methods include the following unique features not found in the cited references: pulse current; high-purity nanocapsule yield; and high dispersion in organic solvent and aqueous solutions.

II. Claims 1, 2, 5-11, 14-16, 19-21 and 24 Satisfy the Written Description Requirement of 35 U.S.C. § 112

At page 2 of the Office Action claims 1, 2, 5-11, 14-16, 19-21 and 24 are rejected under 35 U.S.C. § 112, first paragraph, as allegedly failing to comply with the written description requirement. The Examiner asserts that the claim(s) contain subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the art that the inventor, at the time the application was filed, had possession of the claimed invention. The Examiner further alleges that there is no support for the amendment made to page 2 of the specification.

Applicant respectfully disagrees. The present specification expressly states that "process producing high-purity carbon nanocapsules as well as magnetic metal-filled carbon nanocapsules have been developed." See page 1, lines 26-27 of the specification. While the two copending application cited in further support of this statement were inadvertently omitted from the original specification, persons skilled in the art would recognize (just as the Examiner has recognized), that Application Nos. 10/255,669 (now U.S. Patent 7,156,958) and 10/329,333 (now U.S. Patent 6,872,236) are the applications in question. U.S. Application No. 10/255,669 and U.S. Patent No. 6,872,236 teach a process that yields at least 50% nanocapsules. Thus, based on the disclosure at page 1, lines 26-28 and page 2, lines 1-2 of the specification, a process yielding at least 50% nanocapsules is adequately described in the present application. Applicant submits that the omission of the citations of the copending applications from the original specification was merely a typographical error and inadvertent. In addition, one of ordinary skill in the art would recognize that Applicant described a high yield process as his invention, based on page 1, lines 26-28 and the fact that Applicant has only a small number of U.S. nanocapsule applications and patents (see Appendix A). Additionally, Applicant asserts that the Examiner was readily able to locate the teachings in Applicant's '669 application and '236 patent, as stated at page 3 of the Office Action dated December 29, 2005. Therefore, one of ordinary skill in the art would likewise readily identify and recognize that Applicant in his original specification described a process that yields at least 50% nanocapsules, as his invention.

Accordingly, Applicant traverses the 35 U.S.C. § 112 rejection.

Withdrawal of the rejection is kindly requested.

III. Claims 1, 2, 5-11, 14-16, 19-21 and 24 Are Patentable Under 35 U.S.C. § 103(a)

At page 2 of the Office Action claims 1, 2, 5-11, 14-16, 19-21 and 24 are rejected under 35 U.S.C 103(a) as being unpatentable over Lieber (US 6,159,742), in light of Uchida *et al.* (US 5,560,898). The Examiner rejects claims 1, 2, 5-10, 15, 19, 20 and 24 under 35 U.S.C 103(a) as obvious over Hiura *et al.* (US 5,698,175).

The Examiner alleges that Lieber '742 discloses a carbon nanotube having an organic functionalization. The formula disclosed is: X--(L--M)$_n$, where L--M is deemed to meet the limitation of an organic functional group. The Examiner asserts that despite Applicant's limitation of a nanocapsule, no difference is seen between the nanocapsule of the present invention and the nanotube of Lieber. The Examiner appears to rely on Uchida as disclosing purified nanotubes. The Examiner admits that Lieber does not discuss purity. The Examiner concludes that it would have been obvious to one of ordinary skill in the art to purify the nanotubes of Lieber because doing so provides for a high-sensitivity device without interfering species.

The Applicant respectfully disagrees. Claims 1, 10, 15, and 20 clearly recite "a hollow carbon nanocapsule having a purity of at least more than 50%, and at least one kind of organic functional groups bonded thereon…" It is therefore apparent that the invention provides a high-purity hollow carbon nanocapsule yield of at least greater than 50%.

The Examiner does not appreciate the structural differences between the nanotubes of the references and nanocapsules of the present claims. A tube and a capsule are structurally different.

Lieber discloses nanotubes prepared by arc discharge, as further described by Colbert *et al. Science*, 266, 1218, (1994) (see column 5, lines 5-7). However, in accordance with US 2003/0159917, the formation of carbon nanocapsules requires the application of pulse current (*i.e.*, see Applicant's abstract). Without pulse current, as in Lieber, carbon nanotubes are formed instead of carbon nanocapsules. Assuming *arguendo* that nanocapsules are formed in Lieber, even though they are not, the yield is too trivial to purify due to the strong Van der Waals force

between carbon nanocapsules and carbon nanotubes (*i.e.*, see Lieber [0005]). Thus, Lieber fails to disclose a high-purity hollow carbon nanocapsule. Also, the other cited references teach production of carbon nanotubes.

Further, it is improper to analogize the claimed nanocapsule to a nanotube. The diameter of Applicant's carbon nanocapsule is 3-100nm (*i.e.*, see page 3, line 2 of the specification). However, Lieber teaches that the aspect ratio of a carbon nanotube is at least 5 (*i.e.,* see Lieber, column 2, lines 24-29). The outward appearance and dimensions of carbon nanocapsules and carbon nanotubes are also distinct. These features are appreciated by one of skill in the art since the nanotubes and nanocapsules are used for different purposes. For example, the low-aspect-ratio carbon nanocapsule is used as heat-conducted fluid or drug carrier, whereas, the high-aspect-ratio carbon nanotube is used as field emission display (FED), reinforced fiber, conductive film, or atomic force microscope (AFM) probe.

Additionally, carbon nanocapsules can be functionalized by a redox reaction, cycloaddition reaction, or a radical addition reaction. In the redox reaction, the carbon nanocapsule is reacted with a strong oxidant to oxidize the surface carbon layer of the carbon nanocapsule and form a functional group on the carbon nanocapsule (*i.e.*, see page 4, lines 3-11 of the specification). Thus, functional groups are uniformly distributed over the carbon nanocapsule surface. Lieber teaches that a linking group L (functional group) is bonded at an end of the carbon-based nanotube (*i.e.,* see Lieber abstract). Clearly, functionalized positions of carbon nanocapsules and carbon nanotubes are distinct.

Accordingly, the Applicant herewith provides a summary of how carbon nanocapsules and carbon nanotubes are different. Several distinctions therebetween are shown in Table 1:

Table 1 Distinction Between Nanotube and Nanocapsule

	Nanotube (cited references)	Nanocapsule (invention)
Preparation (US 6,159,742 (Lieber); US 2003/0159917)	Absence of pulse current.	Pulse current required.
Purity (US 6,159,742 (Lieber))	Nanotube is a main product. Nanocapsule is a byproduct (too trivial to purify).	High purity nanocapsule (at least more than 50%).
Dispersion & Aggregation property	High aggregation.	High dispersion in organic solvent and aqueous solution.
Functional group modification (G.S. Duesberg et al *Appl. Phys. A* 1999, 69, 269-274; Jie Liu, et al *Science* 1998, 280, 1253-1256; K. C. Hwang *J. Chem. Soc. Chem. Commun.* 1995, 173-174)	Formed at the two ends thereof due to high aggregation.	Uniformly distributed over the surface thereof due to high dispersion.
Aspect ratio (US 6,159,742 (Lieber))	High, 10~2000.	Low, ~1.
Applications	Suitable for use in Field Emission Display (FED), reinforced fiber, conductive film, and Atomic Force Microscope (AFM) probe due to high aspect ratio.	Suitable for use at least in heat-conducted fluid and drug carrier due to low aspect ratio and high purity.

Thus, Applicant respectfully asserts that the cited references fail to disclose the features of Applicant's invention. Since Applicant's independent claims are not anticipated by the cited references, withdrawal of the rejection is kindly requested. Insofar as claims 2, 5-9, 11, 14, 16, 19, 21, and 24 depend from claims 1, 10, 15 and 20, respectively, these claims are also patentable.

VI. Claims 1, 2, 5-10, 15, 19, 20, and 24 Are Patentable Over Hiura *et al.*

In the Office Action at page 3, claims 1, 2, 5-10, 15, 19, 20, and 24 are rejected under 35 U.S.C. § 102(b) as allegedly being anticipated by Hiura *et al.,* U.S. Patent No. 5,698,175. The Examiner relies on assumptions that carbon nanotubes and carbon nanocapsules are analogous. In addition, the Examiner suggests that Hiura *et al.* disclose purification and functionalization of hollow nanotubes. The Examiner admits that purity is not reported *per se*.

Applicant respectfully disagrees. As discussed in III. above, the Examiner's analogy of nanotubes to nanocapsules is technically flawed. Applicant incorporates the arguments contained in Section III. above herein, which establish that carbon nanotubes and carbon nanocapsules are not analogous. In addition, Applicant's high purity process is not disclosed by Hiura *et al.*

Because Applicant's invention is not disclosed or suggested by Hiura *et al.*, reconsideration and withdrawal of the rejection are kindly requested.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,

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Appendix A.

Industrial Technology Research Institute
Gan-Lin HWANG Nanocapsule U.S. Applications and Patents

U.S. Application/ Publication No./ Patent No.	Status	Title	Disclosure of High Purity Process
11/002,674 20060009404	Pending	Hetero-nanocapsule and method of preparing the same	No
10/740,403 20040238799	Allowed 03.05.2007	Polymer-chain-grafted carbon nanocapsule	No
10/606,965 20040126303	Pending	Organically functionalized carbon nanocapsule	No
10/255,669 20030159917 7,156,958	Patented 01.02.2007	Preparation of hollow carbon nanocapsules	Yes
10/329,333 20050056119 6,872,236	Patented 03.29.2005	Preparation of magnetic metal-filled carbon nanocapsules	Yes